# Space Weather Technical Forecast

Issued on Saturday, 11 June 2022 at 01:15 Local

**This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

## Space Weather Forecast Headline: Chance of further M-class flares.

## Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Solar activity was Moderate over the UTC day of Friday 10 June, with the largest X-ray flare recorded at GOES16 an M1.2 peaking at 10/1055UTC from a sunspot region on the northeastern horizon of the sun. There were two numbered sunspots at peak in the period, and possibly two further unnumbered, however 3029 has now largely faded to plage having briefly attained Bxi/Beta complexity, while a second unipolar Axx group also faded in the northern solar hemisphere near the meridian. This left the northeastern limb as the main area to watch, with AR3030 presenting as a Dao/Beta and perhaps having a nearby eastern companion, which although less clear for a narrow viewing angle, perhaps manifested as a Dko/Beta at peak.

A disappearing filament was evident leaving the northwestern quadrant at around 10/1700UTC on H-Alpha imagery (such as El Teide). At the time of writing there is no obvious ejecta visible on coronagraphs, however this will be monitored. The only events visible on coronagraph imagery stem from east limb or far-side activity, and these are not expected to affect Earth.

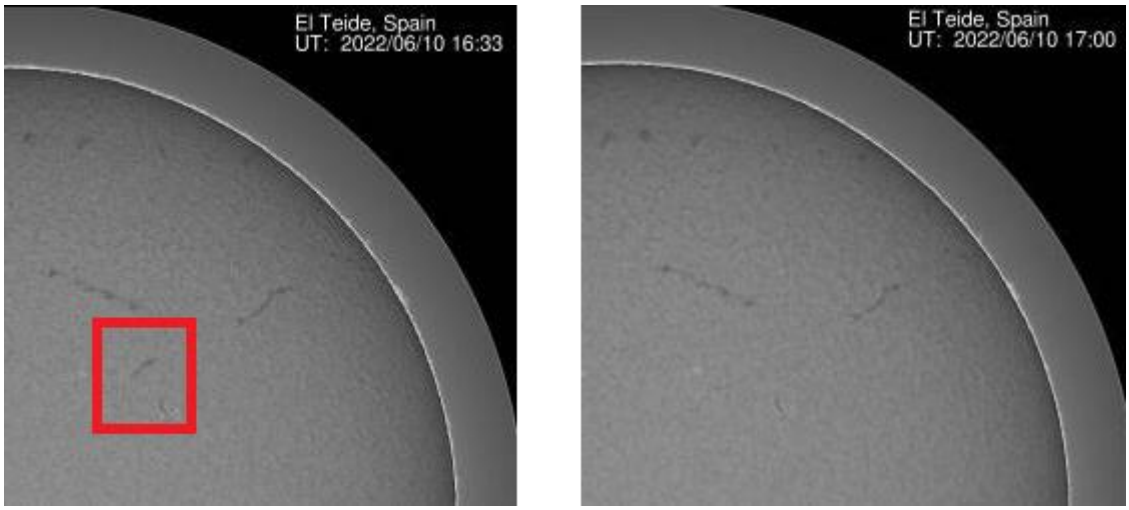


**Figure 0: H-Alpha imagery of disappearing filament in northwest quadrant around 10/1700UTC. There is not yet any evidence that this feature left the immediate solar environment, however it will be monitored.**

**Solar Wind / Geomagnetic Activity:** The solar wind, as observed by DSCOVR and ACE at L1, was mostly characteristic of a slow regime, albeit with a minor Solar Sector Boundary Crossing at 10/0900UTC, again at 10/1300UTC and a third at 10/2330UTC. This was most clear in the phi angle, which while mostly negative (towards the sun) spent the midday period and very end of the day in a positive orientation. The solar wind speed was nevertheless near background levels throughout, ranging between 275 and 325km/s. The solar wind density was a little more

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animated, peaking near 20ppcc between the SSBCs, but otherwise occupying a more typical range in single figures ppcc. The IMF peaked at 8nT, with the north-south component ranging between +/-6nT.

The overall effect of the above solar wind measures on geomagnetic activity was Quiet throughout, peaking at a provisional Kp 2+ in the 00-03UTC but otherwise declining over the UTC day.

**Energetic Particles / Solar Radiation:** The high energy proton flux (10 MeV) was at Background levels.

Electron flux (greater than 2MeV) was mainly within Normal Background levels. Corresponding 24-hour integrated electron fluence has been well below the Active (1e8 integrated pfu) threshold on a slightly rising trend, finishing the 24 hours with an observed value of 1.83e6 integrated pfu at 10/2400UTC.

## Four-Day Space Weather Forecast Summary

**Solar Activity:** Solar activity is Expected to be mainly Low, but with a daily Chance of further M-class flares, mainly from the two sunspot regions close to the northeast limb. No sunspot regions leave the disc in the period, however further bright regions may rotate onto the earth-facing disc in the coming days, with a tentative increase in risk therefore suggested.

**Solar Wind / Geomagnetic Activity:** No Earth-directed CMEs currently feature in the forecast. Recent STEREO A measurements echoed by Enlil suggest a high speed stream as potentially arriving on day two, Sunday 12 June, although being near the solstice activity should be muted, perhaps Active at peak on an otherwise mainly Quiet forecast.

**Energetic Particles / Solar Radiation:** High energy proton flux (greater than 10 MeV) is expected to be at Background levels during this period.

High energy electron flux (greater than 2 MeV) is expected to vary between Normal Background and Moderate levels. Electron fluence is expected to remain below the Active threshold throughout, with probably a slight upward trend in fluence levels during the period, mainly in the wake of any uptick from an expected weak coronal hole.

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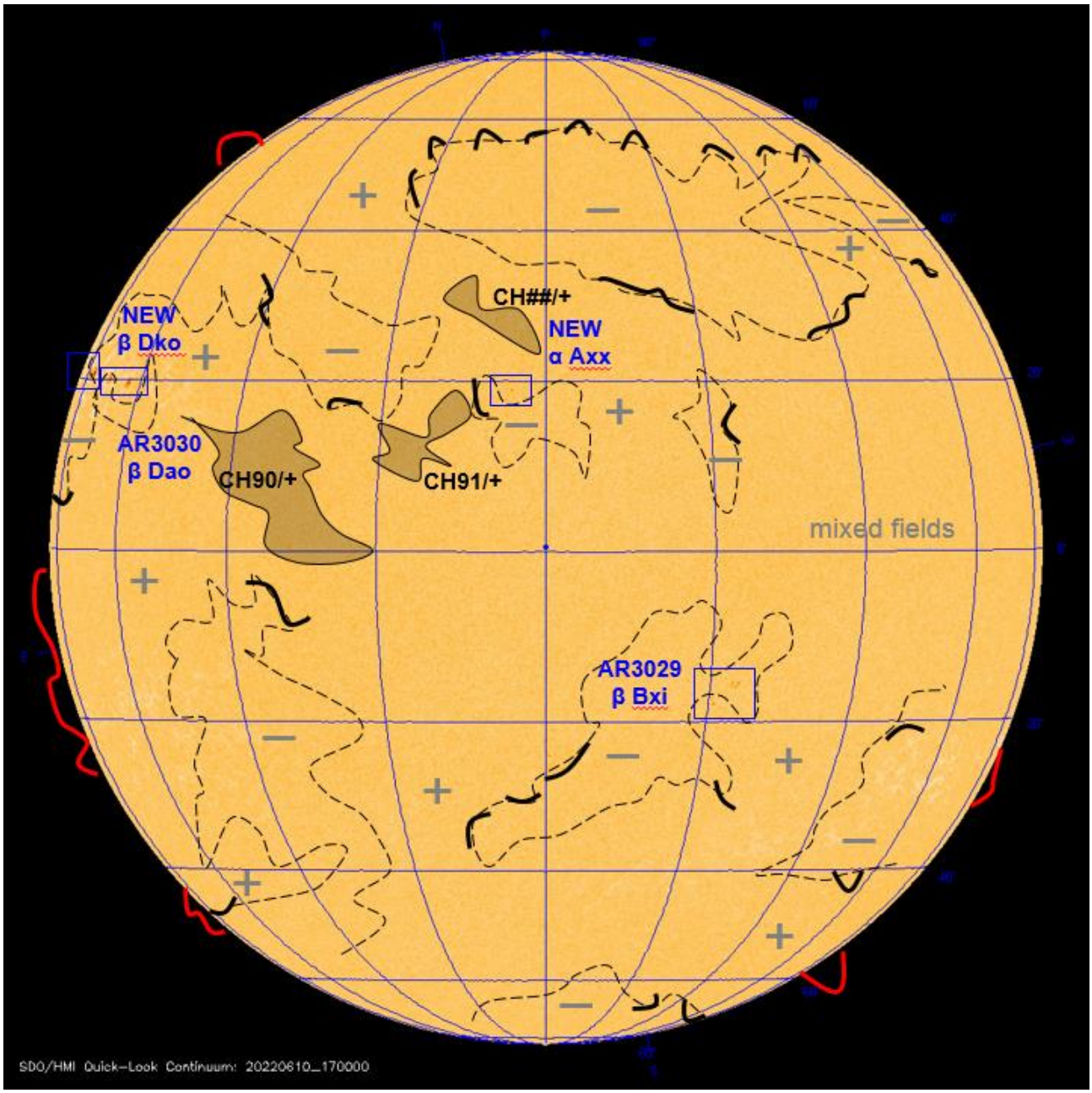
**Figure 1. Solar Analysis Valid 10/1700UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

No CMEs feature in the current forecast. While not evident on current AIA193 imagery, historically there has been a small coronal hole visible in the northwest quadrant with a larger analogue from previous rotations (CH87/+). This may be the cause of a recently observed near-500km/s high speed stream at STEREO A, with this increase also suggested by the latest MOSWOC Enlil modelling.

Should this enhancement occur, the geomagnetic effects are likely to be muted, both because of the hole's small stature but also because of our proximity to the summer solstice, with isolated Active intervals perhaps possible at peak later Sunday 12 June, but probably more likely Unsettled. This is the only deviation from an otherwise Quiet forecast that should have resumed before the current four-day period is out.

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 1 | 1 | 1 | 1 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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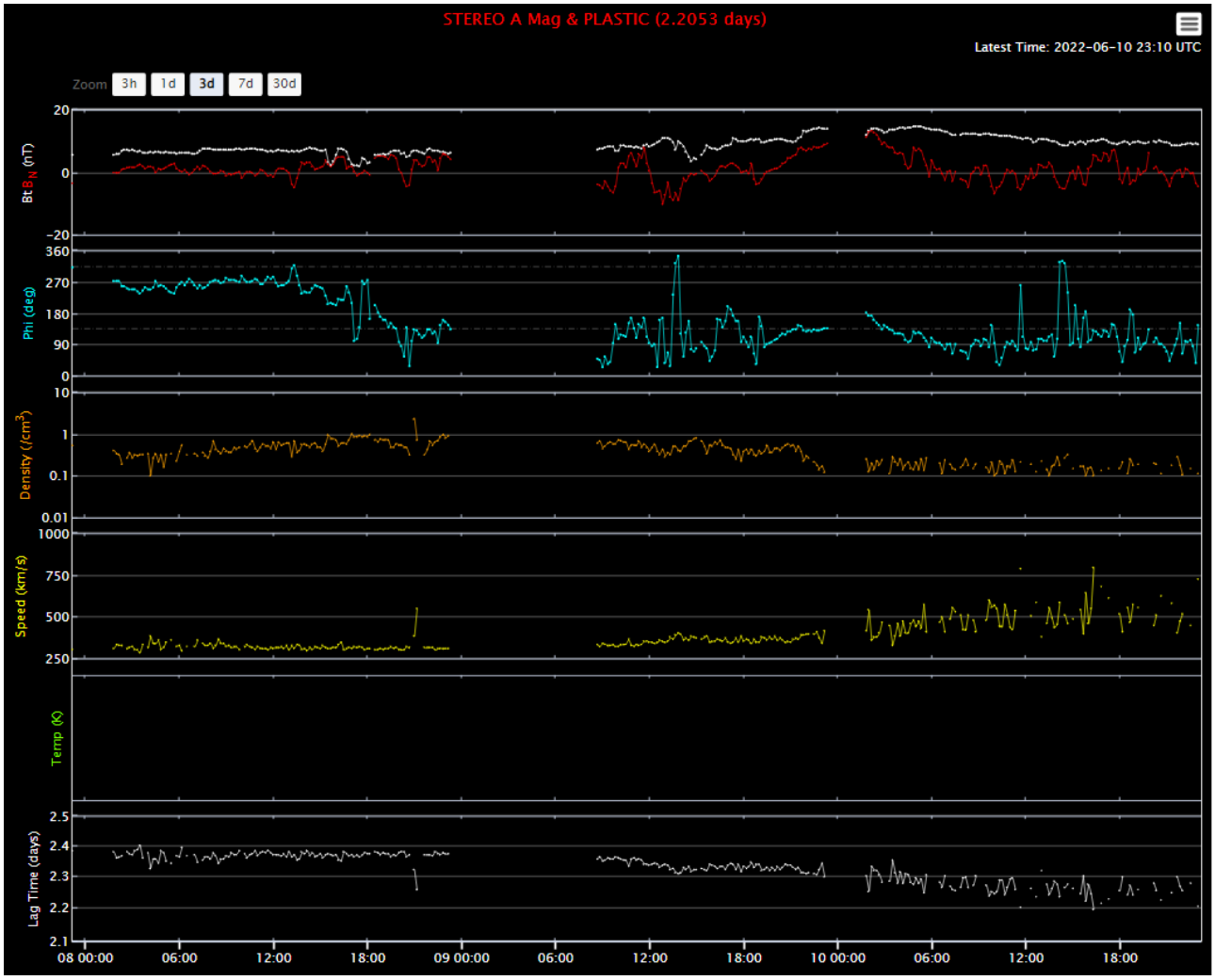
**Figure 2: 3-Day STEREO A MAG and PLASTIC trace showing enhancement in solar wind speed as affecting the satellite at present. The speed trace is particularly noisy, however is perhaps suggestive of a fast wind of around 500km/s, perhaps from CH87/+, although this is perhaps surprising given its apparently small stature on the disc.**




## Radio Blackouts - X-Ray Flares:

The Earth-facing disc is now dominated by the northeastern limb sunspot groups, especially given the fading of AR3029 and an unnumbered unipolar spot in the northern solar hemisphere. The partition of groups on the northeastern limb itself is open to doubt given the narrow viewing angle, however it now appears that there are at least two groups here, including a Dao/Beta in the form of AR3030, and perhaps a near-neighbour that appears as a Dko/Beta. The M-class flare of 10 June appears to have been at least partly tied to a large sunspot behind the limb, which may also have produced a CME in the early hours of the same UTC day.

All considered, the northeastern limb remains an area to watch, with an increase in X-ray activity posited for the outlook period, supported by recent flares, CMEs and STEREO A EUVI 195 imagery. This region of the sun contains the remnants of Ex-3014 and Ex-3017, which gave M and X class flares on their last foray onto the front side, and it remains to be seen whether they remain capable of similar given there presumed maturity.

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| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 25 | 30 | 30 | 30 |
| Very Active | R3 to R5 X Class | No | 3 | 5 | 5 | 5 |

**Figure 3: Cylindrical projection of the sun in 195 Angstroms, showing impending bright flux regions over the northeastern and perhaps later southeastern solar horizon. The northern feature in particular perhaps offers the higher chance of generating X-ray activity given its history.**

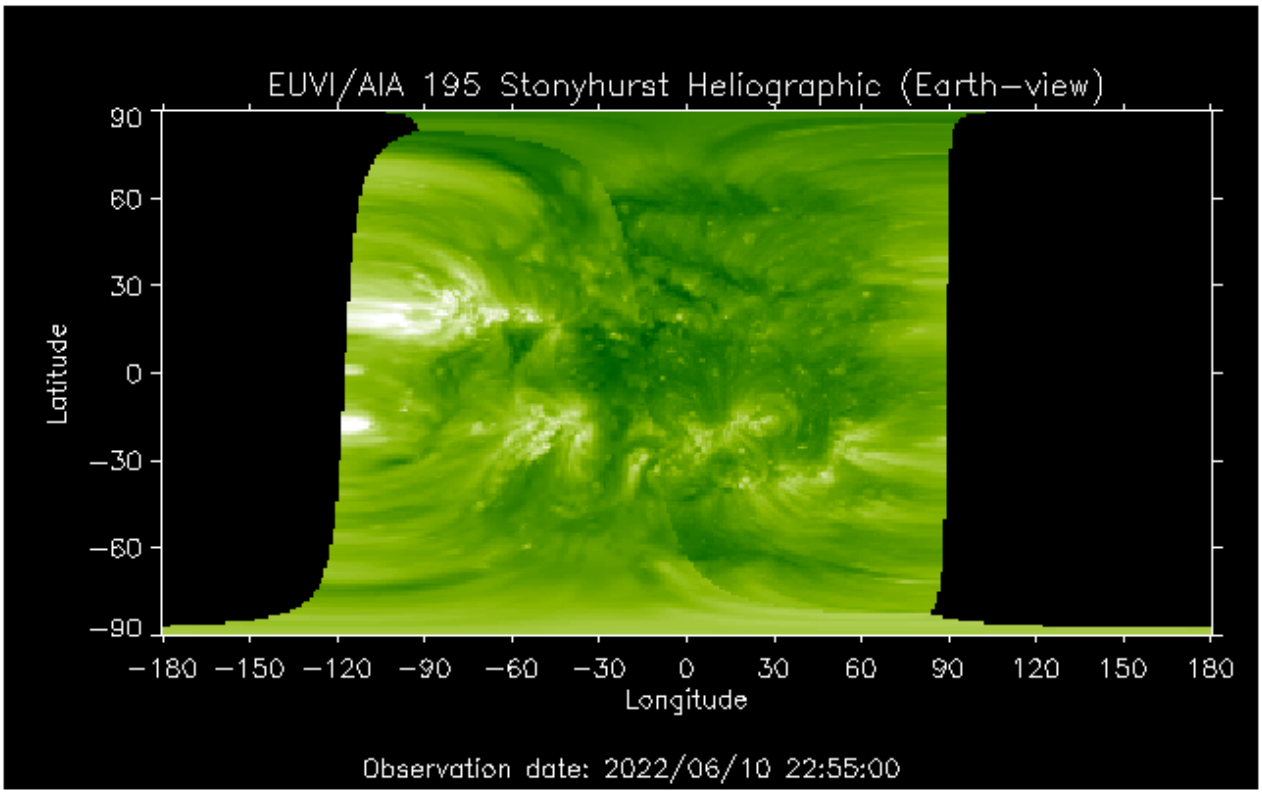


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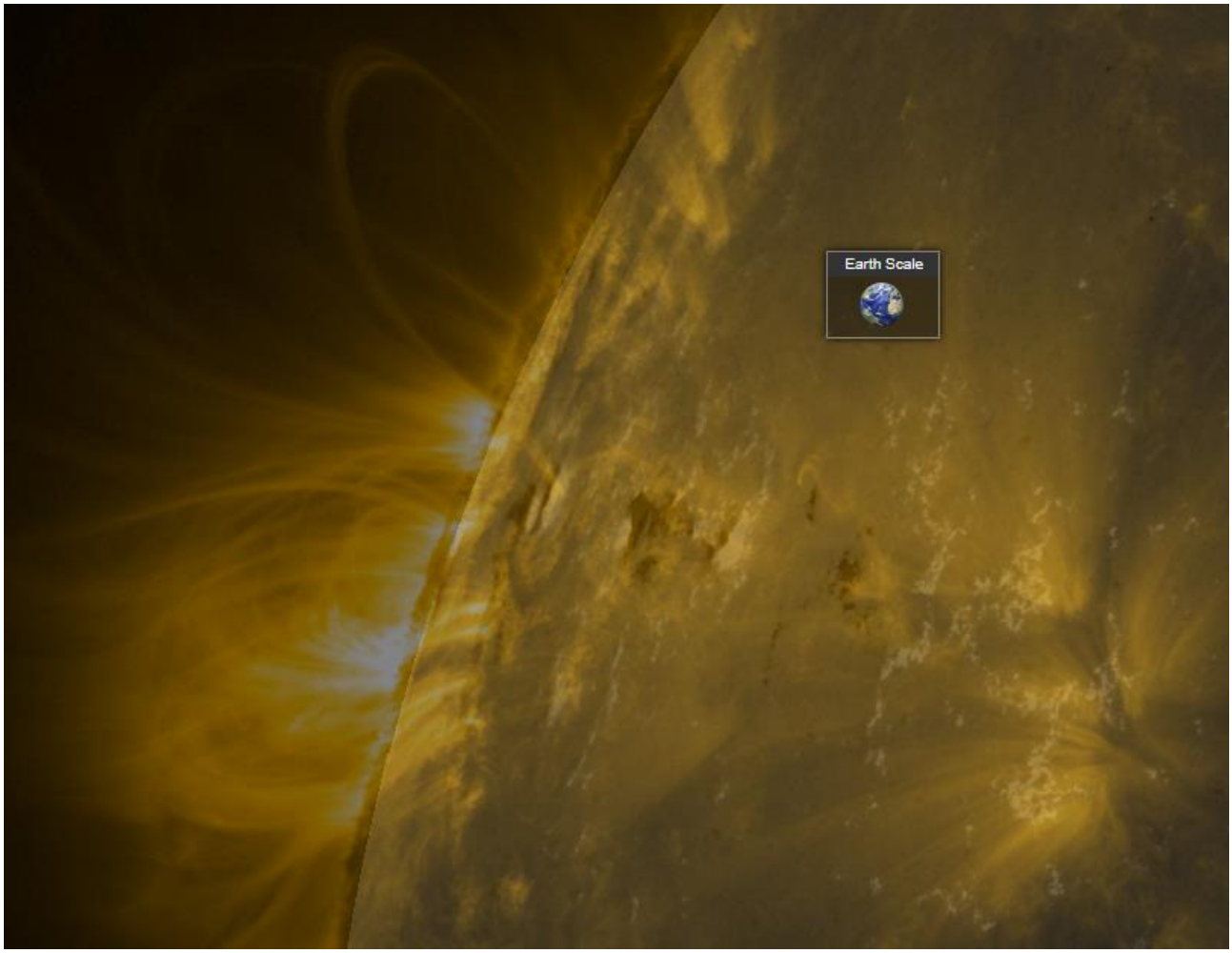
**Figure 4: Helioveiwer.org-generated composite image from 10/2200UTC showing AIA 171 and HMIB imagery overlaid. This highlights the complexity of AR3030, its neighbour and perhaps arriving region(s) over the northeastern limb. Also shown is the Earth for scale.**




## Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at Background levels and is expected to remain at this level through the period in the absence of significant sunspot regions in the western hemisphere.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 1 | 1 | 1 | 1 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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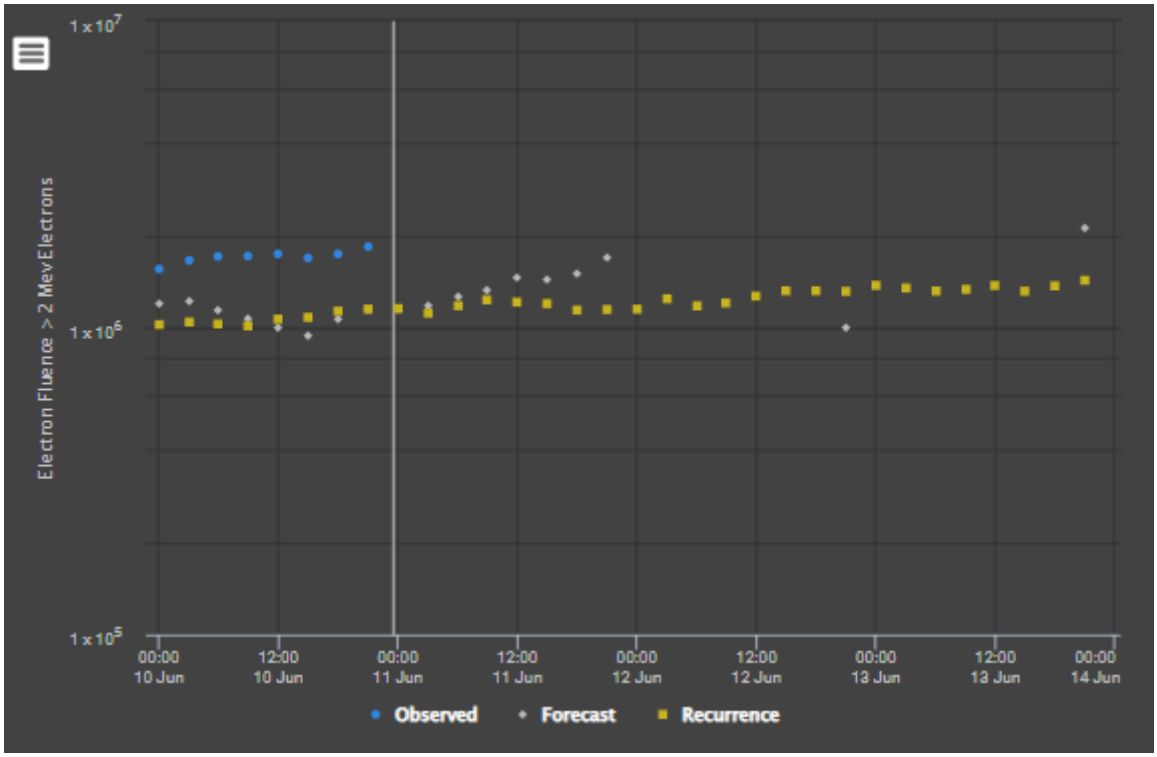
## High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to remain at mainly Normal Background levels through the next four days, perhaps with a slightly rising outlook as a result of any influence from what is presumed to be minor coronal hole 87, as seen at STEREO A in recent hours. This is unlikely to prove capable of generating Active electron fluence, and current MOSWOC REFM guidance is accepted in its rising, but comfortably sub-Active 72-hour forecast trend.

| GEO Electron Environment | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ 2 MeV ≥ $1x10^{8}$ | No | 1 | 1 | 10 | 20 |
| Very Active | ≥ 2 MeV ≥ $1x10^{9}$ | No | 1 | 1 | 1 | 1 |

**Figure 5: Latest MOSWOC REFM forecast (white dots), observed 24-hour fluence values (blue dots) and persistence 24-hour fluence (yellow dots). All are in good agreement, and the slight trend upwards in the 72 hours is accepted.**

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